Chatbot Application on Internet Of Things (IoT) to Support Smart Urban Agriculture

Reza Gunawan
Department of Informatic Engineeering
UIN Sunan Gunung Djati Bandung
Bandung, Indonesia
rezagunawan999@gmail.com

Ichan Taufik
Department of Informatic Engineeering
UIN Sunan Gunung Djati Bandung
Bandung, Indonesia
ichsan@uinsgd.ac.id

Edi Mulyana
Department of Electrical Engineeering
UIN Sunan Gunung Djati Bandung
Bandung, Indonesia
edim@uinsgd.ac.id

Opik T Kurahman
Department of Informatic Engineeering
UIN Sunan Gunung Djati Bandung
Bandung, Indonesia
opik@uinsgd.ac.id

Muhammad Ali Ramdhani
Department of Informatic Engineeering
UIN Sunan Gunung Djati Bandung
Bandung, Indonesia
m_ali_ramdhani@uinsgd.ac.id

Mahmud
Department of Tarbiyah and Education
UIN Sunan Gunung Djati Bandung
Bandung, Indonesia
mahmud@uinsgd.ac.id

***Abstract* - Information about the condition of the plant is certainly useful to do actions for plants to maintain the quality of these plants. The Internet of Things can help to inform the condition of the plant so that if there are circumstances that require further action such as watering can be informed immediately. In this study the tools used are wemos ESP8266 micro-controller that can be connected to Wi-Fi connected to the internet so that the data state from the sensor can be sent immediately via the internet. Sensors that are attached to plants are temperature, soil moisture, air humidity and light, the data sent to the web application uses the REST API service. The Web application sends the data to the mobile application and Line Chatbot. Natural Language Processing method in chatbot applications as message processing to approach Indonesian language. The result is the user's response in asking about the condition of the plant can be answered and notification of the condition of the plant can be sent. Data delivery must be received as fast as possible for the user to test it for how many seconds the sensor data is sent to the user, from 40 data samples there are delay about 1-3 seconds to be accepted by the user. For further research, sensors are needed which are more varied with the number and type of different plants and testing with sensor data compression.**

Keyword–IoT, Smart Urban Agriculture, Line Chatbot, Natural Language Processing, REST API

I. INTRODUCTION

Internet of Things (IoT) is considered technology and economic wave in the global information industry after the internet. IoT is an intelligent network that connects everything to the Internet for the purpose of exchanging information and communicating through devices, sensing information in accordance with agreed protocols. [1] Some fields have implemented Internet of Things, namely in the field of environmental monitoring, control of electric power and transportation [2].

The field that is being vigorously realizing IoT is agriculture. Because the agriculture process cannot be predicted with certainty and is very dependent on weather conditions and unexpected events such as pests and diseases. Especially for agriculture in urban areas the uniqueness of existing urban agriculture such as limited land, more extreme weather / climate changes compared to rural areas far from cities, pollution problems, limited planting medium, limited water, and traffic problems in distribution, information is very necessary accurate and up-to-date so that with these limitations, the production can still be maximized [3]. The problems that exist in the field of agriculture, it takes one tool or sensor that can convey information about the temperature, humidity, soil moisture and lighting can affect the optimization of agricultural production in the midst of urban residents busy, the existence of IoT will help manage the information quickly and precision through a mobile application interface that can be accessed quickly.

The importance of interactive interactions from applications to users is a technological breakthrough today. Artificial intelligence is a technology that mimics behavior like humans. Called a smart application that has knowledge coupled with experience and reasoning to make decisions and take action. Research from Prathibha Made a system for managing sensor data about temperature, air humidity on the agricultural field. If there is a significant change in the plant, the sensor can send an MMS (Multimedia Messaging Service) message in the form of an image of the condition of the farm.[4]

Hanjong Choi, [5] Creating an interactive chatbot system in the manual of an electronic device. A chatbot can guide users to use an electronic device and receive orders from users to do it automatically on electronic devices. Besides that Cyril Joe Baby, [6] Creating an IoT system with a web that has a chatbot feature to send information, then all tools can be controlled and use security, that is, only certain users can access the

978-1-7281-4796-3/19/$31.00 ©2019 IEEE

application and send an email when someone is not detected by the sensor.

LINE is a chat, call, and video call service and in Indonesia has acquired more than 90 million users. The Messaging API is already present and developed by LINE, this service provides communication between the systems built by developers and users such as Chatbot[7]. By utilizing IoT as a sensor that can transmit data related to air humidity, soil moisture, light conditions, and ambient temperature so how farmers can monitor using an Android mobile application. And the use of API LINE @ Messaging how to guide farmers to find out changes that occur from the data sensor.

II. RESEARCH METHODS

A. Identification of problems

System problem analysis aims to determine the problems and needs needed to build a mobile and Line Bot based Smart Urban Agriculture system. The main problem is how to transfer data between sensors from IoT devices to mobile applications. For that delivery on the mobile application will take advantage of the fire rest service data from the talk tree website application. In addition, making Line Bot with Line Messenger requires an algorithm that is able to translate questions from users so that they get the right answers. For this reason the Natural Language Process algorithm approach is used to sort out the basic words and discard unnecessary words.

B. Internet of Things

The chatbot and mobile application is an application in the Smart Urban Agriculture IoT system. The process of sending data from various sensors such as temperature sensors, humidity, soil PHP and light implanted in plants. All data will be sent with an intermediary wifi sensor in the talk tree application as a cloud computing storage media with Json's data format.

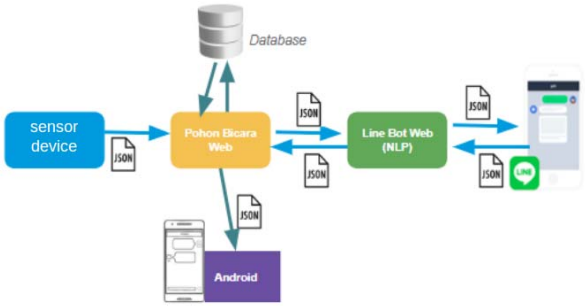

Figure 1 The chatbot System Architecture with IoT

In Figure 1 illustrate the components for building this system:

1. Sensor tool

The sensor consists of a temperature sensor, air humidity, soil moisture and light. This sensor is connected to the ESP 8266 microcontroller so that it can connect with Wifi and send sensor data to the Web Talk Tree. Sensor tools within 3 seconds send data to the Web Talk Tree, but not all data is stored in the Database. But only the data that will be sent as a notification to the user and the data stored is the data that the user wants through the chatbot.

2. Pohon Bicara Web

The Pohon Bicara Web is the center of the flow of data from the sensor to the user chat. Here is a service API that provides data requirements for all components formed in JSON

3. Database

The database here store sensor data plus data from NLP knowledge such as basic words, stopwords, stemming questions and answers of the question.

4. Line Bot Web (NLP)

The Line Web Bot serves to process the message and doing NLP method on each message. At any NLP process requires a database of web talking tree that stores data knowledge.

5. Android and Line App

The android can receive the data transmitted by sensor. The Line App is used by the user to receive notifications from sensor data or ask questions about the state of the plant.

C. Application of NLP on Line of The Chatbot

The application of NLP on the Chatbot Line used to how to reply to a message from the user so that the results of matches or nearly a reply message to the user's wishes. The first process is tokenized to divide the message into a few words. Said filtering process is then carried out which filter out words that are not needed or called stop words. These stop words stored in a database so that users stay than just a message, once it is done Stemming process to transform the word into a word basic word. This can be illustrated in Figure 2 as follows.

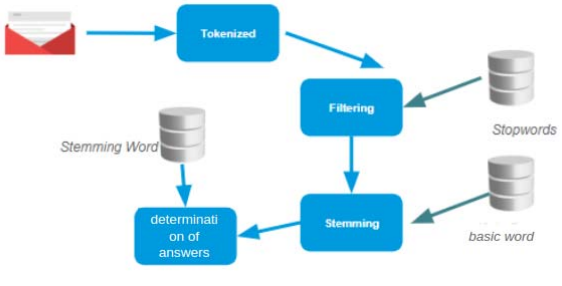

Figure 2 Determination Process Answers

For example, if the user sends a message to an application to contain "How Soil Moisture at this time, then?". Here is a message answer for later processing times specified. The first tokenized message through the process to split into an array. Described in figure 3 as follows

Figure 3 Process tokenized

Then the tokenized results filtered by removing the unneeded based database of stop words table. Here is the process filter

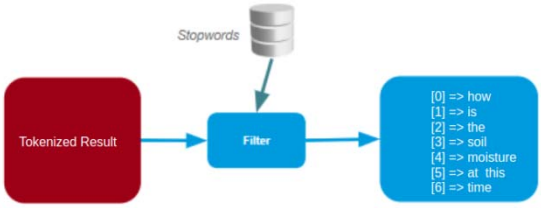

Figure 4 Filter Process

After filtering results obtained subsequent to the stemming process that is changing a word being said base. The algorithm used is Nazier and Adriani, this algorithm basically eliminate affix Indonesian words into basic words that exist in the database dasar.Proses word Stemming is carried out as follows

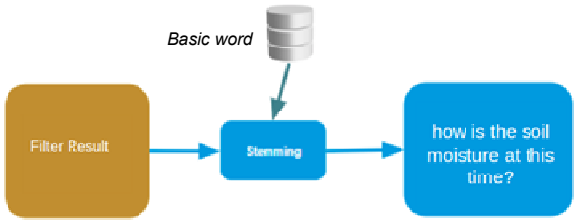

Figure 5 Stemming Process

D. *Nazief & Adriani Algorithm*

Stemming is a process to obtain basic word in a word. The Stemming process in a sentence separate each word from the base and add prefix or suffix. Nazief & Adriani algorithm first developed by Bobby Nazief and Mirna Adriani. The algorithm is based on the rule of Indonesian extensive morphology, collected into one group and in-encapsulation of the additive / affixes allowed (allowed affixes) and affix / affixes are not allowed (disallowed affixes). [8]

The steps of the Nazief & Adriani algorithm are:

1) Check the word in the dictionary, if found, the word is considered as the correct base word and the algorithm is stopped.
2) Eliminate Inflectional suffixes, ("-lah", "-kah", "tah" or "-pun"),
3) Eliminate the infectious possessive pronoun suffixes ("me", "you" or "it"). 4) Repeat step 1, if not then proceed to step 5.
4) Delete Derivational Suffix ("-i" or "-an", ").
5) Repeat step 1, if not then proceed to the next step.
6) If the ending "-an" has been deleted and the last letter of the word is "-k", then "-k" is also deleted. Repeat step 1, if not, then proceed to the next step.
7) Endings that are deleted ("-i", "- an" or "-kan") are returned, proceed to the Next step.
8) Remove Derivational Prefixes ("be -", "in -", "to -", "me -", "pe -", "" and "te -"). Repeat step 1, if not then continue, then do the recording.
9) If all the steps have been carried out but had no base word, the word that has been done previously returned as the initial process. [8]

III. IMPLEMENTATION

A. *Implementation of IoT Smart Urban Agriculture*

IoT smart design of urban agriculture uses Wemos Esp8266 as a microcontroller. Plus four sensors that can transmit data such as temperature, soil moisture, light intensity and real-time sensor with time. Following a series of smart IOT urban agriculture can be seen in Figure 6 as follows.

Figure 6 The Smart Urban Farming IoT Implementation

The stages carried out in the implementation of sensor devices are as follows:

1. Controller configuration to connect with Wifi will be used
2. Controller configuration in order to read the installed sensors
3. Then, check whether the sensor device can send data to the Pohon Bicara Web.

Scenarios carried out by means of the sensor as follows :

1. A sensor within three seconds to send the data to the Pohon Bicara Web

2. If the data transmitted suppose a notification for watering plants, then the data will be sent to the chatbot and the data stored in the database
3. If the user is asked through the chatbot, Tree Talk then the web would allow a sensor to reply to a message and the transmitted data is stored in the database.
4. If the sensor is off / has internet interference. Then the Pohon Bicara web will send the last sensor data stored on the database.

B. Web Service Implementation

Here is a table of the implementation of the use of Web Service API. Contains functions - API functions that can be accessed by each component of the system. Starting from post sensor function for sensor devices that can send data to the system. Then push message so that the system can send a chat on the LINE app. NLP process using API NLP because the data stored on the web so that the chatbot Talking Tree Line requires data access such basic words, stopwords, and stemming questions.

TABLE 3.1 API TABLES

API Link	Method	Usability
sensornew/{id}	GET	Display the latest sensor data
gettemperature/{id}	GET	Display temperature data
gethumidity/{id}	GET	Display humidity data
getsoilhumidity/{id}	GET	Display soil moisture data
getlight/{id}	GET	Display light state data
getplant/{id}	GET	Display crop data
getdevice/{id}	GET	Display device data
postsensor	POST	Send sensor data from the tool to the web
pushmessage	POST	Send data from the sensor to the chatbot
getbasicword	GET	Get basic word data
getstopword	GET	Get stopwords data
getstemquestion	GET	Getting the data steam question
postuserquestion	POST	Sending a message that is not found answers to the chatbot
poststemuser	POST	Sending a message that has been done and the stemming process is not found answers
notifon	POST	Activate notification
notifoff	POST	Disable notifications

C. Implementation of the Application Interface

The pohon bicara application mobile interface is built using a programming language dart flutter. The following figure 3.1 shows the implementation of the tree talking.

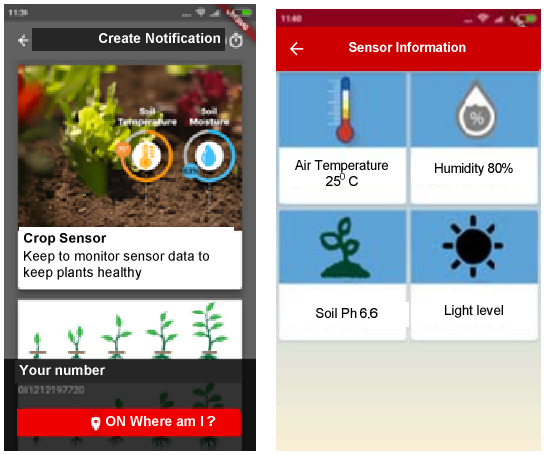

Figure 3. 1 The Implementation of the Application Interface

D. Line Bot Implementation

Line Bot is a service of the application tree to talk, so that one can communicate interactively with the exchange of information messages. Messages sent in the form of a notification of change of sensor data at regular intervals. In addition, users can send messages directly to inquire cool the sensor data, the message will be read by the appropriate Line Bot then reply to questions.

The user can push message corresponding grooves that have been given by Line Bot like to ask how air temperature in the plant, then the user can type "refer to the temperature sensor". Then the API Line Message will interpret the sentence and find the right answer to that question is typed.

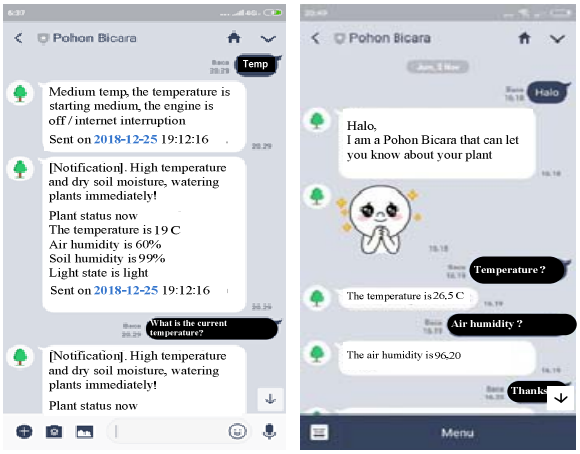

Figure 3. 2 The Get Implementation and The Push Message Line Bots

E. The NLP Data store Implementation

In the following Figure 3.3 shows a basic word that is stored on the system. This basic word table is used when the NLP process is run.

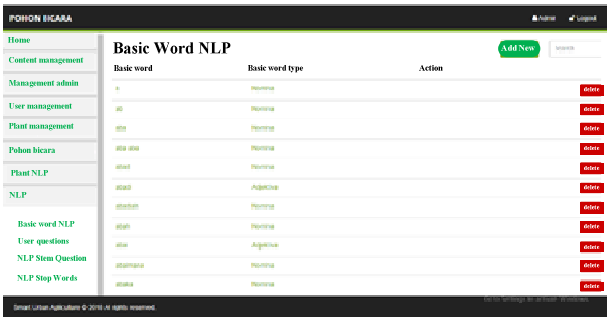

Figure 3. 3 The NLP Basic Word Implementation

In the following Figure 3.4 shows a table containing the questions and answers that can be answered by the system.

Figure 3. 4 The Implementation of User Questions

In The following Figure 3.5 shows a table that contains a question that has been done process stemming and answers that can be answered by this system. Table a reference where the most appropriate response when the user asks.

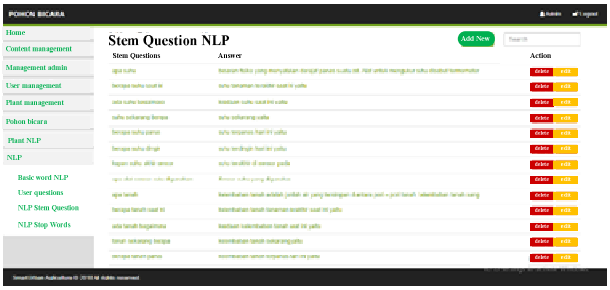

Figure 3. 5 The Implementation of the Questions System

In the following Figure 3.6 shows the implementation of the stopwords. This table contains words that will be truncated when a sentence or message is sent by the user to the chatbot. This process is called filtering where unneeded words are stored in the database, then used when the filtering process occurs.

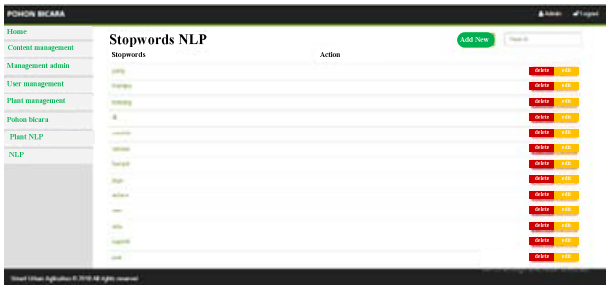

Figure 3.6 The stopwords Implementation

IV. RESULT AND TESTING

A. The Real time Data Sensor Testing

Readings of temperature sensor, humidity, soil moisture and light conditions which are then sent by the ESP8266 controller to the internet, to the web service that will be sent to the chatbot can be tested how quickly the data from the sensor can be received. How fast the data transmission affects with several factors, namely the amount of data sent, the internet speed used and the ability of the server to receive data. The following is a testing table of how much time the sensor data is sent to the web service from several samples of data transmission trials From the table above there is an average delay of 1.5 seconds, of course this is quite fast because the sensor data is still small and the internet connection is adequate.

TABLE 4. 1 THE TESTING OF REAL TIME SENSOR DATA

Date & Time	Humidity	Temperature	Light intensity	Date & Time	Delay
18-11-07 20:09:00	97.90 %	27.30 ° C	1 (bright)	18-11-07 20:08:59	1 second
18-11-07 21:19:05	99.90 %	27.30 ° C	1 (bright)	18-11-07 21:19:18	3 second
18-11-07 21:19:05	99.90 %	27.30 ° C	1 (bright)	18-11-07 21:19:18	3 second
18-11-07 21:19:08	99.90 %	27.30 ° C	1 (bright)	18-11-07 21:19:18	3 second
18-11-07 21:19:10	99.90 %	27.30 ° C	1 (bright)	18-11-07 21:19:18	3 second
18-11-07 21:19:13	99.90 %	27.30 ° C	1 (bright)	18-11-07 21:19:18	1 second
18-11-07 21:19:06	99.90 %	27.30 ° C	1 (bright)	18-11-07 21:19:18	1 second
Average	97.4%	27.25 ° C	1 (bright)		1.5 second
The smallest Data	97.7%	27.2 ° C	0 (dark)		1 second
The biggest	99.8%	27.4 °	1(bright)		2

Data		C			second

B. The Chatbot System Testing

Here in the following Table 4.2 shows the chatbot system testing to test whether the chatbot can answer questions according to the Dictionary / stored on database. The result shows that the chatbot can answer in accordance with the data stored knowledge. But if questions outside of that then chatbot can not pinpoint the exact answer.

TABLE 4. 2 THE CHATBOT SYSTEM TESTING

No	Question	Answer	Result
1.	What is temperature	Magnitude of physics which states degree heat	success
2.	What is the current temperature	the latest plant temperature	success
3.	What is the temperature situation	current temperature of sensors	success
4.	what's the hottest temperature	hottest temperature from sensors	success
5.	what is the coldest temperature	lowest temperature of sensors	success
6.	what is the last temperature of the sensor	last temperature of sensors	success
7.	what temperature tool is used	Sensor used	success
8.	what is soil moisture	The amount of water stored in the soil	success
9.	What is the current humidity	Current humidity of sensors	success
10.	What is the highest humidity	highest humidity from sensors	success

V. CONCLUSIONS AND SUGGESTION

A. The Conclusion

Based on the description and discussion of the analysis of testing has been done, it can be concluded towards the chatbot application to support Smart Urban Agriculture IOT as follows:

1) The sensor can send temperature data, soil moisture, air humidity and light to the chatbot via a web service with the REST API. Data sent to the Web then the data is sent to the Line API messaging to the user to know the state of the plant. The results of the realtime sensor data is that there is a time lag between sensor data and web data, namely there is a pause of 1-3 seconds with an average aiming of 1.5 seconds. This is influenced by the speed of the Internet connection with a download speed of 40 Mbps.

2) Sensor data can be displayed interactively using LINE chatbot. Each message sent by a user through tokenized, filtering, and stemming with Nazief and Adriani algorithms can then be determined according to the user's question. The results of the chatbot can answer questions submitted by the user according to the knowledge data stored on the chatbot. Questions outside the knowledge chatbot data will answer which is not in accordance with the question.

B. The Suggestion

Based on the above conclusions, the suggestions that can be put forward for future development are as follows:

1. More research is needed on sensor voters that can be needed to monitor plant quality
2. Questions on Line Bot are related to data sensors, so add a brain file to increase chatbot knowledge. Further application of NLP is needed.
3. Sensor data transmission is very dependent on internet connection.

ACKNOWLEDGMENT

This research was supported by Research and Publishing Center UIN Sunan Gunung Djati Bandung, Indonesia

REFERENCES

[1]. J. A. Stankovic, “Research Directions for the Internet of Things,” *Internet Things Journal, IEEE*, vol. 1, no. 1, hal. 3–9, 2014.

[2]. S. hen, H. Xu, D. Liu, B. Hu, dan H. Wang, “A vision of IoT: Applications, challenges, and opportunities with China Perspective,” *IEEE Internet Things J.*, vol. 1, no. 4, hal. 349–359, 2014.

[3]. 류대현, “SNS를 IoT 플랫폼으로 이용한 도시농장 관리시스템 개발 TT - Development of Urban Farm Management System using Commercial SNS as IoT Platform,” 한국인터넷방송통신학회 논문지, vol. 13, no. 5, hal. 149–154, 2013.

[4]. S. R. Prathibha, A. Hongal, dan M. P. Jyothi, “IOT Based Monitoring System in Smart Agriculture,” *2017 Int. Conf. Recent Adv. Electron. Commun. Technol.*, hal. 81–84, 2017.

[5]. H. Choi, T. Hamanaka, dan K. Matsui, “Design and implementation of interactive product manual system using chatbot and sensed data,” *2017 IEEE 6th Glob. Conf. Consum. Electron.*, no. Gcce, hal. 1–5, 2017.

[6]. C. J. Baby, F. A. Khan, dan J. N. Swathi, “Home Automation using IoT and a Chatbot using Natural Language Processing,” hal. 1–6, 2017.

[7]. L. Chatbot, “LINE Chatbot,” no. September, 2017.

[8]. D. Wahyudi, T. Susyanto, dan D. Nugroho, “Implementation and analysis of Nazief & Adriani and Porter algorithms derived from Indonesian documents (“Implementasi dan analisis algoritma stemming nazief & adriani dan porter pada dokumen berbahasa indonesia,”) page. 49–56, 2013.